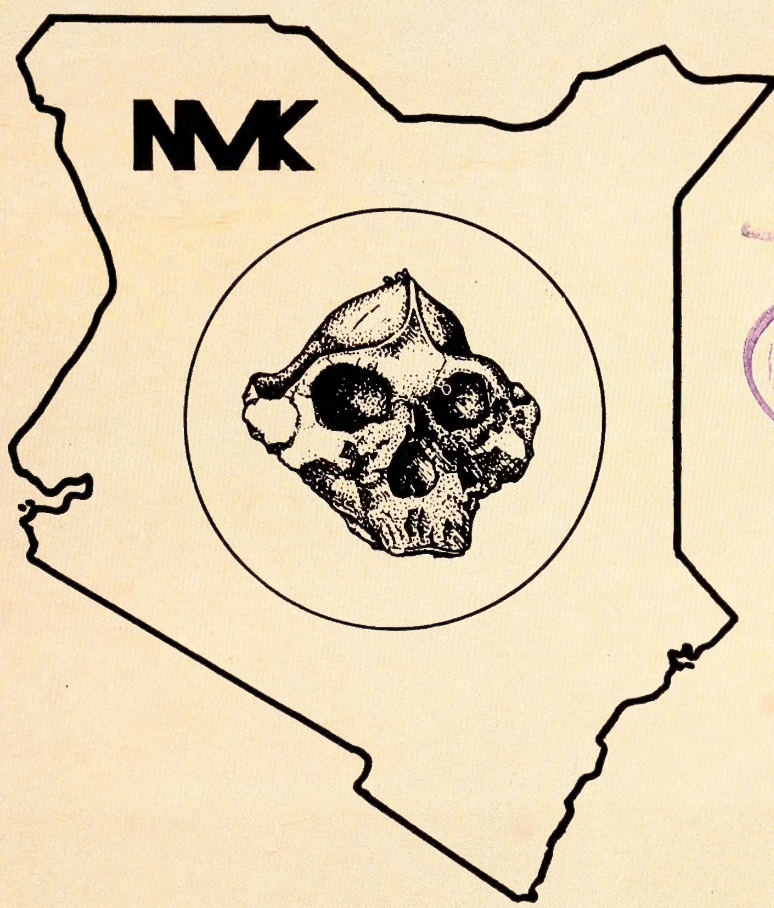
UTAFITI

OCCASIONAL PAPERS OF THE NATIONAL MUSEUMS OF KENYA



NATIONAL MUSEUMS OF KENYA

VOLUME 1 NUMBER 1 JUNE 1988

U T A F I T I

OCCASIONAL PAPERS OF THE NATIONAL MUSEUMS OF KENYA

The National Museums of Kenya wishes to announce the publication of a new scientific journal, UTAFITI. Utafiti is intended to publish the results of the many research programmes conducted by the research staff of the National Museums plus eminent scholars affiliated to it. Research papers are anticipated from the broad areas of natural sciences, incorporating botany, zoology, and earth sciences; and anthropology, incorporating archaeology, paleontology and physical anthropology.

Three to six issues are expected to appear annually and the journal is already in its second volume (1989). So far, two issues of this volume have since been published. Within the limited period of its existence, Utafiti appears to have established itself as one of the leading scientific journals in the two disciplines on the continent. Its editorial board comprises both nationally and internationally established scientists.

Subscription Rates

a) Overseas subscriptions, including postage by surface mail - US $ 30.00 renewed annually in January.

b) Local subscriptions including postage ____ Kshs. 350.00 per year.

Payment in the form of International Money Order, Bankdrafts, or local cheques in case of local subscribers, should be made payable to: "The National Museums of Kenya".

And sent to:

Librarian
National Museums of Kenya
P.O. Box 40658
NAIROBI, Kenya

Volume I issues published in 1988 are also available at current rates.

N/B. Payment must accompany the order

Utafiti, Vol. 1, No. 1, pp. 1 to 22, 1988

Vegetation and Modern Pollen Rain at Olorgesailie, Kenya

Joseph Mworia,[1] Agnes Dallmeijer,[2] and Bonnie Jacobs[3]

(Received November 1985)

Abstract-----Vegetation studies based on two transects of 100 metres each have been analysed in their relative percentage coverage and the occurrence frequency. Eight surface soil samples taken from the two transects were analysed for their pollen contents. A comparison was made between the relative percentages of the taxa common in both the vegetation and pollen samples. A trap sample obtained through a period of one year was analysed for pollen content and compared with pollen spectra from soil samples. Three types of artificial pollen traps were used to obtain one month pollen records to establish the most useful type of trap.

INTRODUCTION

Pollen grains deposited on the ground surface, and in lake and bog sediments bear a relationship to the surrounding vegetation (Birks 1979; Bradshaw 1981; Ibe 1984; Jacobs 1982). This relationship serves as the basis for interpreting the fossil pollen record.

Pollen released from the anthers finds its way to the stigma of the same species in various ways. Transport is carried out over long or short distances either by animals or through the forces of wind and water current. Understanding what can happen during dispersal is essential, in order to interpret the origin of a pollen assemblage at a certain site. Studies of contemporary pollen rain and its relationship to modern vegetation are necessary for correct interpretation of fossil pollen spectra. Two main approaches have been used for such studies: the analysis of surface samples of soil, peat, and lake sediments, and trapping air-borne pollen in specially constructed traps.

The study reported here was undertaken to determine the relationship between the present vegetation and modern pollen rain in the area around Olorgesailie archeological site. To achieve this, two vegetational transects were studied and from the same transects eight surface soil samples were taken and their pollen contents analysed. Three types of pollen traps were used to obtain one month pollen records. A one year pollen record was obtained from one trap.

STUDY AREA

The site is situated in the Eastern Rift Valley (1°30° S and 36°30° E) at the altitude of 990 m above sea level. The mean annual rainfall is 600 mm.

The vegetation around Olorgesailie archeological site is composed of *Acacia* -- *Commiphora* bushland. According to Trump (1967) and Isaac (1968) the area around Olorgesailie can be characterised as semi-arid, with evaporation far exceeding precipitation. The dominant tree species in the bushes are *Acacia tortilis, Acacia senegal, Commiphora africana* and *Commiphora campestris. Delonix elata* occurs with scattered distribution throughout the area. Common amongst the low shrubs are species of *Sericocomopsis, Barleria, Aerva* and *Indigofera. Acacia mellifera* is one of the most frequent bush constituents, while other common bushes and small trees are *Terminalia* spp., *Balanites* spp., *Grewia* spp., *Boscia coriacea* and *Salvadora persica.* Most of the trees are deciduous, coming into leaf only after rain.

MATERIALS AND METHODS

Vegetation study

Two transects each of 100 m. length were studied. The transects were established in a place where the vegetation appeared to be representative of the area and rather homogeneous in its floral composition. As shown on the map (Fig. 1) the two transects were laid across one another with their mid points intersecting at right angles. The centimeter coverage was recorded for each plant encountered along the transect. The height of each plant above ground level was estimated using a 2 m. pole. The 2 m. pole was used for tall plants as well but heights were estimated by a person standing at a distance from the plant. Plants were collected, given numbers and pressed for identification in the herbarium. A profile sketch was made on graph paper in the field.

For each transect the total coverage by plants was summed in centimetres. The same was done for each species present along the transect. From this the relative percentage cover per species was established. Absolute

---

[1]Palynology Department, National Museums of Kenya, P.O. Box 40658, Nairobi.

[2]I.T.C., Private Mail Bag 14, Banjul, Gambia.

[3]Shuler Museum of Paleontology, Institute for the Study of Earth and Man, Southern Methodist University, Dallas, Texas 75275.

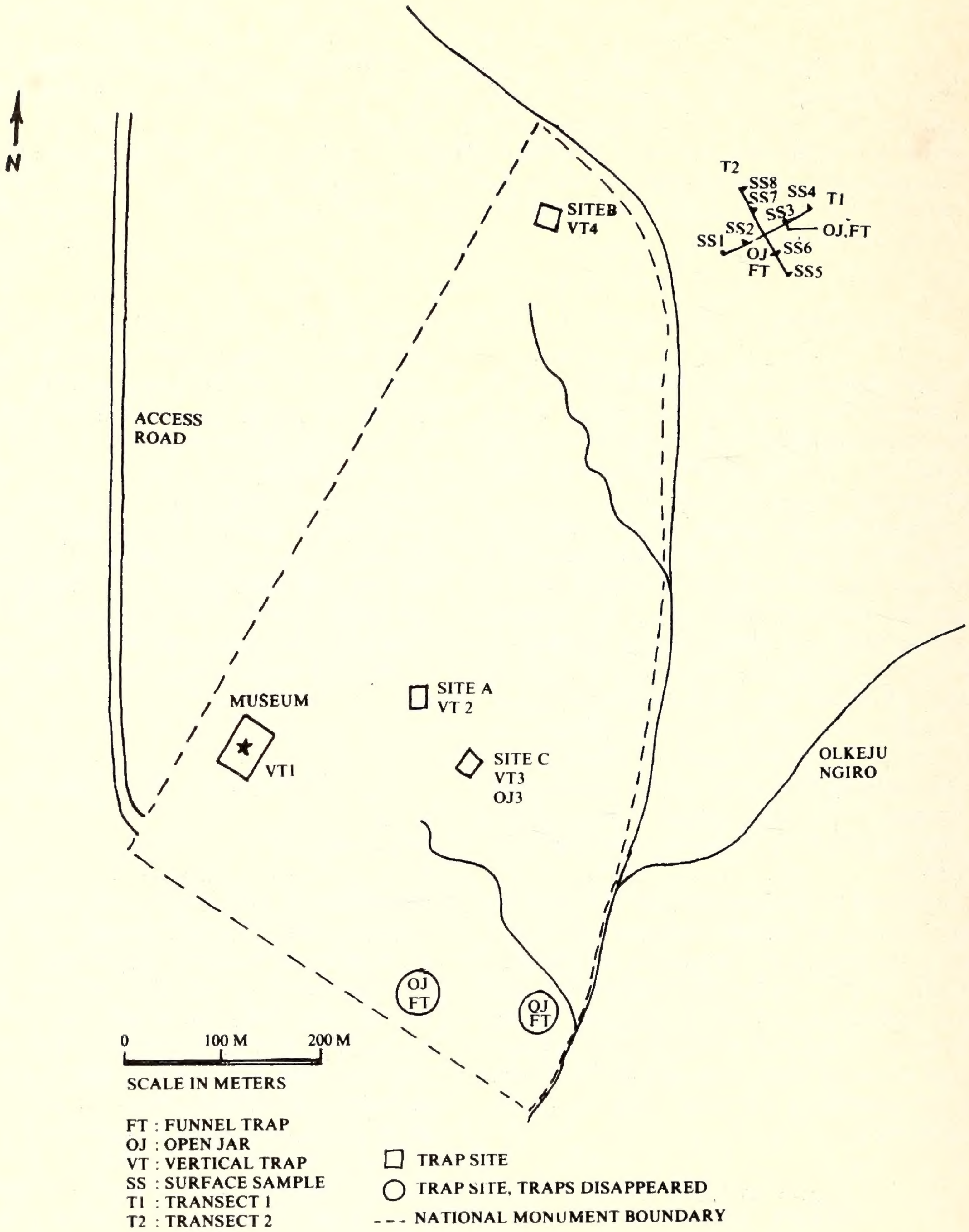


Figure 1. Study area: Olorgesailie National Monument

cover in centimetres and relative percentages were also calculated for genera to facilitate comparison with pollen taxa. The plants were grouped into trees, shrubs, herbs and grasses plus sedges according to descriptions made by Dale and Greenway (1961) and Agnew (1974). Further percentage coverage within these groups were calculated to show species dominance in each category.

Pollen traps

Three types of pollen traps were constructed for use in sampling (Fig. 2). The funnel trap consisted of a large (approximately 1 litre) jar with an infitting upright plastic funnel lined with cotton gauze soaked in a mixture of glycerine and phenol.

An open jar measuring 7 cm high and 8 cm diameter, with a small amount of glycerine with phenol was used as the open jar trap.

The vertical trap was made of a 20 cm sided square wood frame, 2.5 cm thick, and with a one metre wood support from the middle of one side. Cotton gauze was taped on the frame covering the square space and smeared with a mixture of glycerine and phenol.

The traps were placed at various spots in the study area, (Fig. 1). All the vertical traps were placed under the roofs of excavation sheds to avoid washing off by rain. Eight surface soil samples (four from each transect) were collected for pollen analysis. The soil samples were collected within intervals of 25 m. along the transects. A month later samples from nine o the traps (4 vertical, 3 funnel and 2 open jar traps), were collected. The other traps unfortunately disappeared.

Laboratory processing and pollen analysis

The samples were prepared for pollen analysis using the method described by Faegri and Iversen (1975). The method includes KOH treatment and acetolysis for samples with apparently high organic contents, which was the case in trap samples. Soil samples were treated with HCl and HF in addition to KOH and acetolysis, as they contained sand and siliceous material. The full preparation procedure is in Appendix I. Identification of pollen grains was based on comparison with the reference slides from the National Museums of Kenya and published pollen floras, (Bonnefille 1969, 1971, Bonnefille & Riollet 1980. Caratini & Guinet 1974, Hamilton 1976, Heusser 1971, Kingham 1976, Moore and Webb 1978, Senesse 1980, Ferguson and Strachan 1982). New reference slides were prepared from herbarium material, to cover as many of the species present in Olorgesailie area as possible.

Pollen grains were identified at various taxonomic levels. In many cases identification was made at the generic level such as *Grewia*, while in other cases only the family level was distinguishable e.g. in Compositae. In one case pollen could only be identified as belonging to either of two families i.e. Amaranthaceae or Chenopodiaceae. The results of the analysis of the different samples are presented in figures 3 and 4.

Pollen and vegetation comparison

To compare the percentages of taxa present in the vegetation with percentages of the same taxa in the pollen counts of the soil samples the data were treated as follows.

Mean of percentages per taxa were calculated for each pollen type from the four soil samples in each transect. A mean was also calculated for the eight soil samples of the two transects together. Relative percentages for taxa encountered in both vegetation and pollen samples are shown in figure 5.

RESULTS

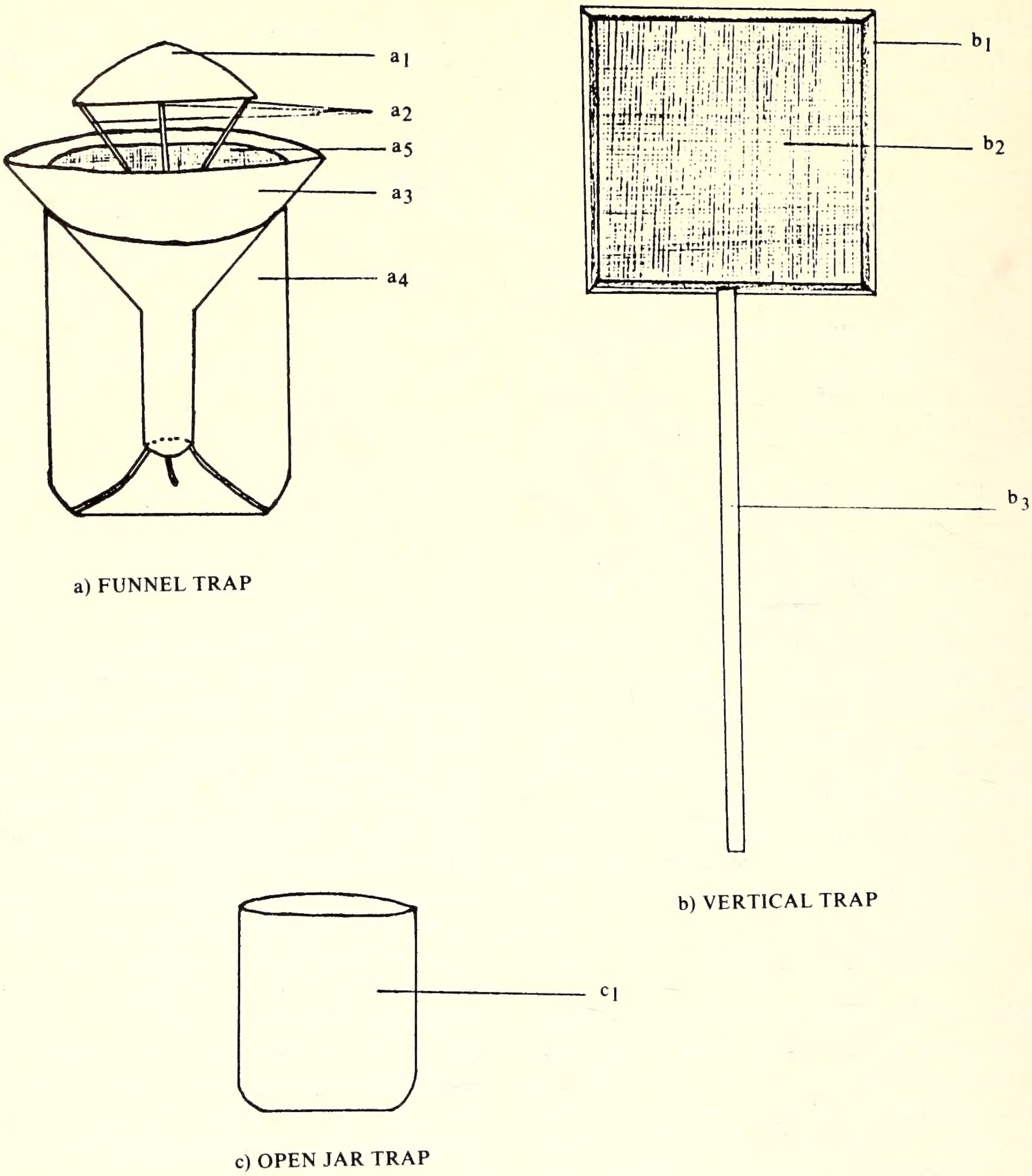
Vegetation transect studies

Some of the results of the transects studies are shown in Tables 1 and 2 (transects 1 and 2). The column farthest to the left represents all the plant species encountered along the transects; shrubs, herbs and grasses together with sedges. In each of the four columns with numbers, the values for a species is on the left and values for a genus is on the right. The first column with numbers shows the coverage in centimetres in the transect. Column 2 shows the number of individual plant counts (frequency). It was not possible to obtain the frequencies for the herbs, grasses and sedges because of their nature. The next two columns represent relative percentages of cover within each structural component and within the whole transect. For example, 3 *Acacia tortilis* trees were encountered along 1480 cms. of the transect. This species comprises 27.1% of all tree coverage and 8.7% of coverage for the transect. The percentage values of the genera present in the vegetation are given to facilitate comparison with pollen percentages, many of which could only be identified to the generic level. Vegetation profile drawings of the transects are given in figures 6a, 6b, 7a and 7b.

Pollen study: Soil surface samples

Results of the soil surface sample analyses are shown in Figure 3. This histogram shows the percentages of each pollen taxon found in the eight surface soil samples, SS_1 - SS_4 from transect 1, SS_5 - SS_8 from transect 2, and in two trap samples (OJ_3 1983 and OJ_3 1984). OJ_3 is open jar trap No. 3; the OJ_3 1983 pollen sample was collected over one month (6th May 1983 to 9th June 1983). The OJ_3 1984 pollen sample was collected over a period of one year (9th June 1983 to 17th June 1984).

Gramineae and Cyperaceae are the first and second most abundant pollen types, respectively, in all the samples. Soil sample number SS_4 had the lowest Gramineae percentage but had highest number of pollen taxa among all the soil samples. Soil sample number SS_1, which had the highest Gramineae pollen percentage, had the lowest number of pollen taxa. In the soil surface samples, pollen from the following plant taxa were well



a_1 funnel cap (plaster)
a_2 metal wires
a_3 plastic funnel
a_4 plastic jar
a_5 cotton gauze

b_1 wooden square frame
b_2 cotton gauze
b_3 wooden supporting frame

c_1 open jar

Figure 2. Atmospheric pollen traps.

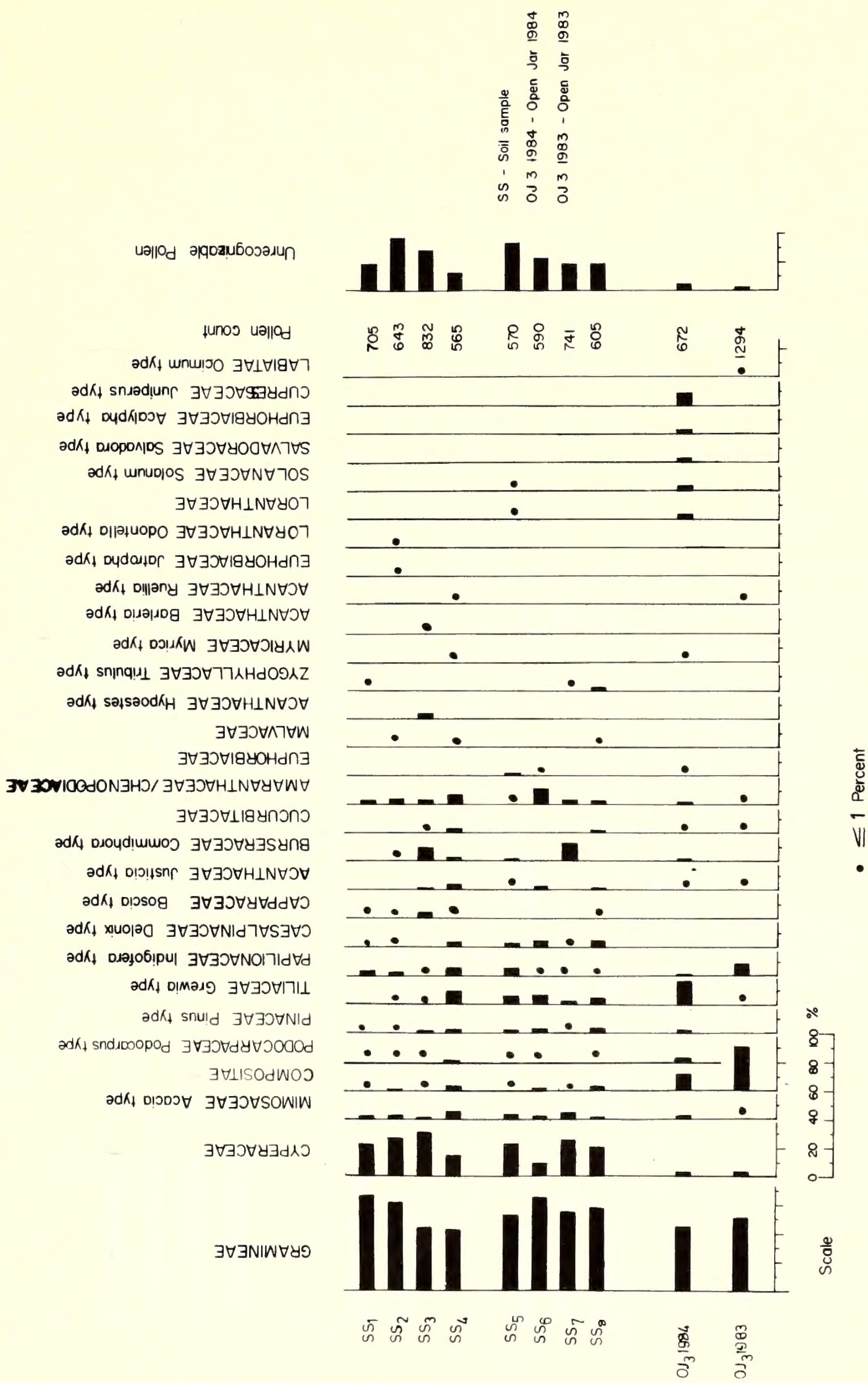


Figure 3. Pollen percentage histograms from 8 surface soil samples. One trap annual record and a one month sample from the same trap.

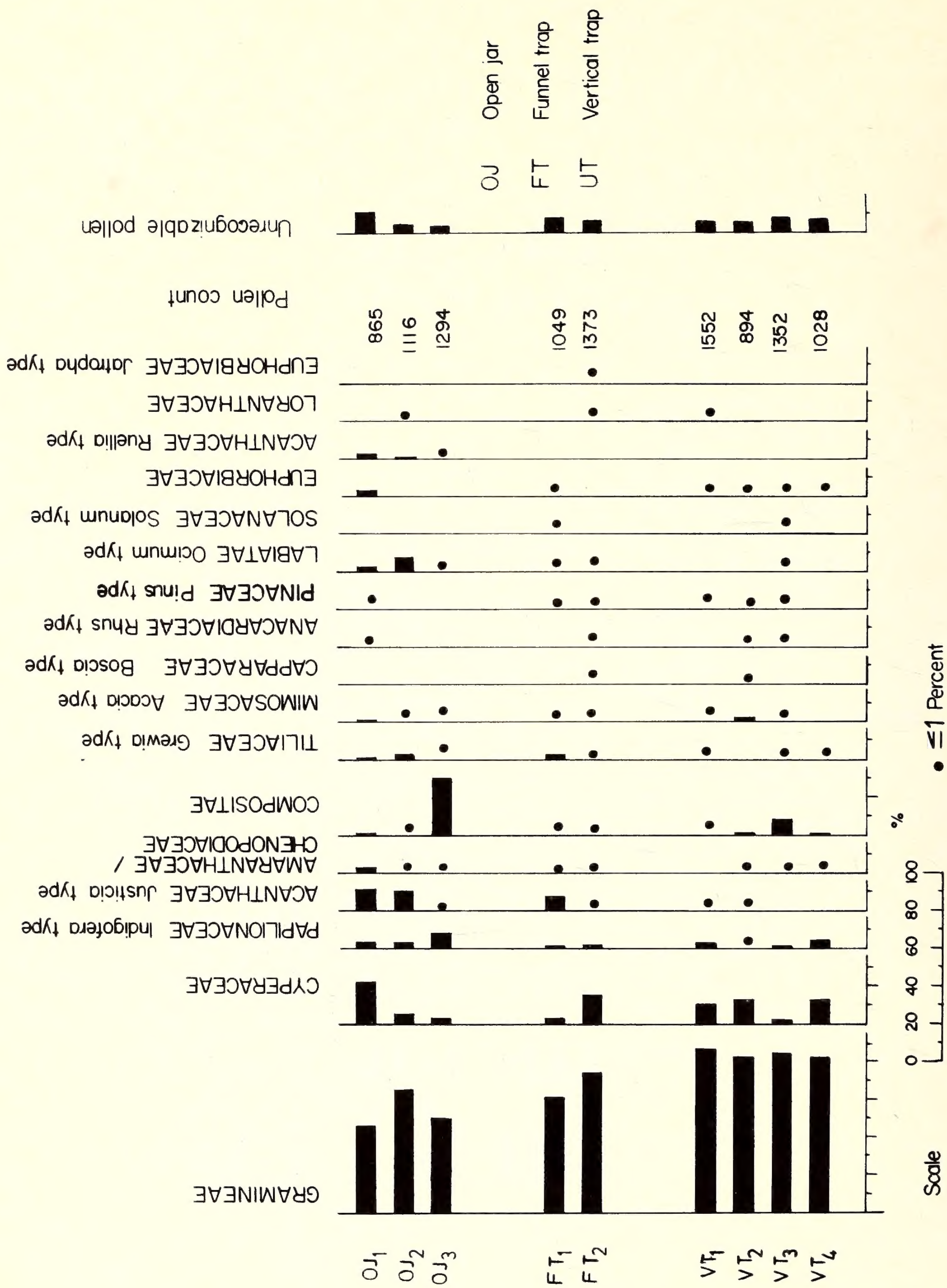


Figure 4. **Pollen percentage histograms from the trap samples.**

Table 1. Transect 1

	Coverage in centimeters		Frequency		Percentage canopy		Percentage transect	
	Species	Genus	Species	Genus	Species	Genus	Species	Genus
TREES								
Mimosaceae								
Acacia tortilis	1480		3		27.1		8.7	
Acacia senegal	1370		4		25.1		8.1	
Acacia sp.	610		1		11.2		3.6	
Acacia		3460		8		63.3		21.6
Burseraceae								
Commiphora campestris	175		3		32.0		10.3	
Commiphora africana	255		2		4.7		1.5	
Commiphora		2005		5		36.7		11.8
SHRUBS								
Tiliaceae								
Grewia tembensis	1615		13		22.9		9.5	
Grewia (unspecified)	1040		6		14.7		6.1	
Grewia bicolor	650		3		9.8		4.1	
Grewia villosa	292		3		4.1		1.7	
Grewia		3637		25		51.5		21.4
Triumfetta flavescens	20		1		0.3		0.1	
Triumfetta		20		1		0.3		0.1
Papilionaceae								
Indigofera spinosa	899		20		12.7		5.3	
Indigofera		899		20		12.7		5.3
Acanthaceae								
Barleria acanthoides	650		16		9.2		3.8	
Barleria eranthemoides	70		1		1.0		0.4	
Barleria		720		17		10.2		4.2
Justicia odora	170		2		2.4		1.0	
Justicia		170		2		2.4		1.0
Ecbolium revolutum	105		2		1.5		0.6	
Ecbolium		105		2		1.5		0.6
Ruellia sp.	12		2		0.2		0.07	
Ruellia		12		2		0.2		0.07
Capparaceae								
Boscia coriacea	380		3		5.4		2.2	
Boscia		380		3		5.4		2.2

Table 1 (cont'd)

	Coverage in centimeters	Frequency	Percentage canopy	Percentage transect
SHRUBS (Cont.)				
Mimosaceae				
Acacia mellifera	210	1	3.0	1.2
Acacia	210	1	3.0	1.2
Euphorbiaceae				
Euphorbia sp.	210	1	3.0	1.2
Euphorbia	210	1	3.0	1.2
Malvaceae				
Hibiscus micranthus	185	2	2.6	1.1
Hibiscus	185	2	2.6	1.1
Pavonia patens	75	2	1.1	0.4
Pavonia	75	2	1.1	0.4
Compositae				
Vernonia cinerascens	180	2	2.6	1.1
Vernonia	180	2	2.6	1.1
Labiatae				
Capitanya otostegioides	112	2	1.6	0.7
Capitanya	112	2	1.6	0.7
Balanitaceae				
Balanites aegyptiaca	80	1	1.1	0.5
Balanites	80	1	1.1	0.5
Solanaceae				
Solanum taitense	60	1	0.9	0.4
Solanum	60	1	0.9	0.4
HERBS				
Agavaceae				
Sansevieria robusta	400		28.6	2.4
Sansevieria	400		28.6	2.4
Scrophulariaceae				
Craterostigma sp.	330		23.6	1.9
Craterostigma	330		23.6	1.9
Amaranthaceae				
Pupalia lappaceae	155		11.1	0.9
Zaleya pentandra	35		2.5	0.2
Amaranthaceae	190		13.6	1.1
Labiatae				
Becium sp. A	135		9.7	0.8
Becium	135		9.7	0.8
Asclepiadaceae				
Diplostigma canescens	120		8.6	0.7
Diplostigma	120		8.6	0.7
Papilionaceae				
Tephrosia lortii	105		7.5	0.6
Tephrosia	105		7.5	0.6

Table 1 (cont'd)

	Coverage in centimeters	Frequency	Percentage canopy	Percentage transect
Commelinaceae				
Commelina bengalensis	45		3.2	0.3
Commelina albescens	20		1.4	0.1
Commelina	65		4.6	0.4
Boraginaceae				
Heliotropium somalense	25		1.8	0.1
Heliotropium	25		1.8	0.1
Vitaceae				
Cissus rotundifolia	20			
1.4	0.1			
Cissus	20		1.4	0.1
Acanthaceae				
Blepharis linarifolia	15		1.1	0.09
Belpharis	15		1.1	0.09
Nyctaginaceae				
Boerhavia erecta	13		0.9	0.08
Boerhavia	13		0.9	0.08
GRASSES AND SEDGES				
Grasses (undifferentiated)	1709		56.9	10.1
Sporobolus jacquemontii	5		0.2	0.03
Enneapogon cendroides	15		0.5	0.09
Grasses	1729		57.1	10.2
Grasses and Sedges	1048		34.6	6.2
Kyllinga welwitschii	249		8.2	1.5
Grasses plus sedges	3026		100	17.9

Table 2. Transect 2

	Coverage in centimeters		Frequency		Percentage canopy		Percentage transect	
	Species	Genus	Species	Genus	Species	Genus	Species	Genus
TREES								
Mimosaceae								
Acacia tortilis	2050		2		48.6		16.5	
Acacia senegal	310		2		7.3		2.5	
Acacia		2360		4		55.9		20.4
Papilionaceae								
Delonix elata	1640		1		38.9		13.2	
Delonix		1640		1		38.9		13.2
Burseraceae								
Commiphora africana	155		1		3.7		1.2	
Commiphora campestris	65		1		1.5		0.5	
Commiphora		220		2		5.2		1.8
SHRUBS								
Tiliaceae								
Grewia (unspecified)	1145		6		21.8		9.2	
Grewia tembensis	785		7		15.0		6.3	
Grewia bicolor	105		1		2.0		0.8	
Grewia		2035		14		38.8		16.4
Triumfetta flavescens	69		3		1.3		0.6	
Triumfetta		69		3		1.3		0.6
Papilionaceae								
Indigofera spinosa	1423		28		27.1		11.5	
Indigofera cufodontii	60		1		1.1		0.5	
Indigofera		1483		29		28.3		11.9
Acanthaceae								
Barleria acanthoides	322		8		6.1		2.6	
Barleria eranthemoides	100		2		1.9		0.8	
Barleria		422		10		8.0		3.4
Ecbolium revolutum	180		2		3.4		1.4	
Ecbolium		180		2		3.4		1.4
Justicia odora	65		3		1.2		0.5	
Justicia		65		3		1.2		0.5
Capparaceae								
Boscia coriacea	425		3		8.1		3.4	
Boscia		425		3		8.1		3.4
Malvaceae								
Hibiscus micranthus	130		5		2.5		1.0	
Hibiscus		130		5		2.5		1.0
Pavonia patens	110		2		2.1		0.9	
Pavonia		110		2		2.1		0.9

Table 2 (cont'd)

	Coverage in centimeters	Frequency	Percentage canopy	Percentage transect
SHRUBS (Cont.)				
Mimosaceae				
Acacia mellifera	170	2	3.2	1.4
Acacia	170	2	3.2	1.4
Solanaceae				
Solanum taitense	100	1	1.9	0.8
Solanum	100	1	1.9	0.8
Loranthaceae				
Odontella ugogensis	55	1	1.0	1.0
Loranthaceae	55	1	1.0	1.0
HERBS				
Agavaceae				
Sansevieria robusta	600		41.8	4.8
Sansevieria	600		41.8	4.8
Papilionaceae				
Tephrosia lortii	298		20.8	2.4
Tephrosia	298		20.8	2.4
Labiatae				
Plectranthus sp.	150		10.4	1.2
Plectranthus	150		10.4	1.2
Becium sp. A	127		8.8	1.0
Becium	127		8.8	1.0
Asclepiadaceae				
Diplostigma canescens	90		6.3	0.7
Diplostigma	90		6.3	0.7
Vitaceae				
Cissus quadrangularis	50		3.5	0.4
Cissus	50		3.5	0.4
Amaranthaceae				
Pupalia lappacea	43		3.0	0.3
Amaranthaceae	43		3.0	0.3
Scrophulariaceae				
Craterostigma sp. C	33		2.3	0.3
Scrophulariaceae	33		2.3	0.3
Euphorbiaceae				
Euphorbia acalyphoides	20		1.4	0.2
Euphorbia	20		1.4	0.2
Commelinaceae				
Commelina bengalensis	20		1.4	0.2
Commelina	20		1.4	0.2
Nyctaginaceae				
Boerhavia erecta	5		0.3	0.04
Boerhavia	5		0.3	0.04
GRASSES AND SEDGES				
Grasses	1465		96.2	11.8
Grasses and Sedges	58		3.8	0.5
Total grasses & sedges	1523		100	12.3

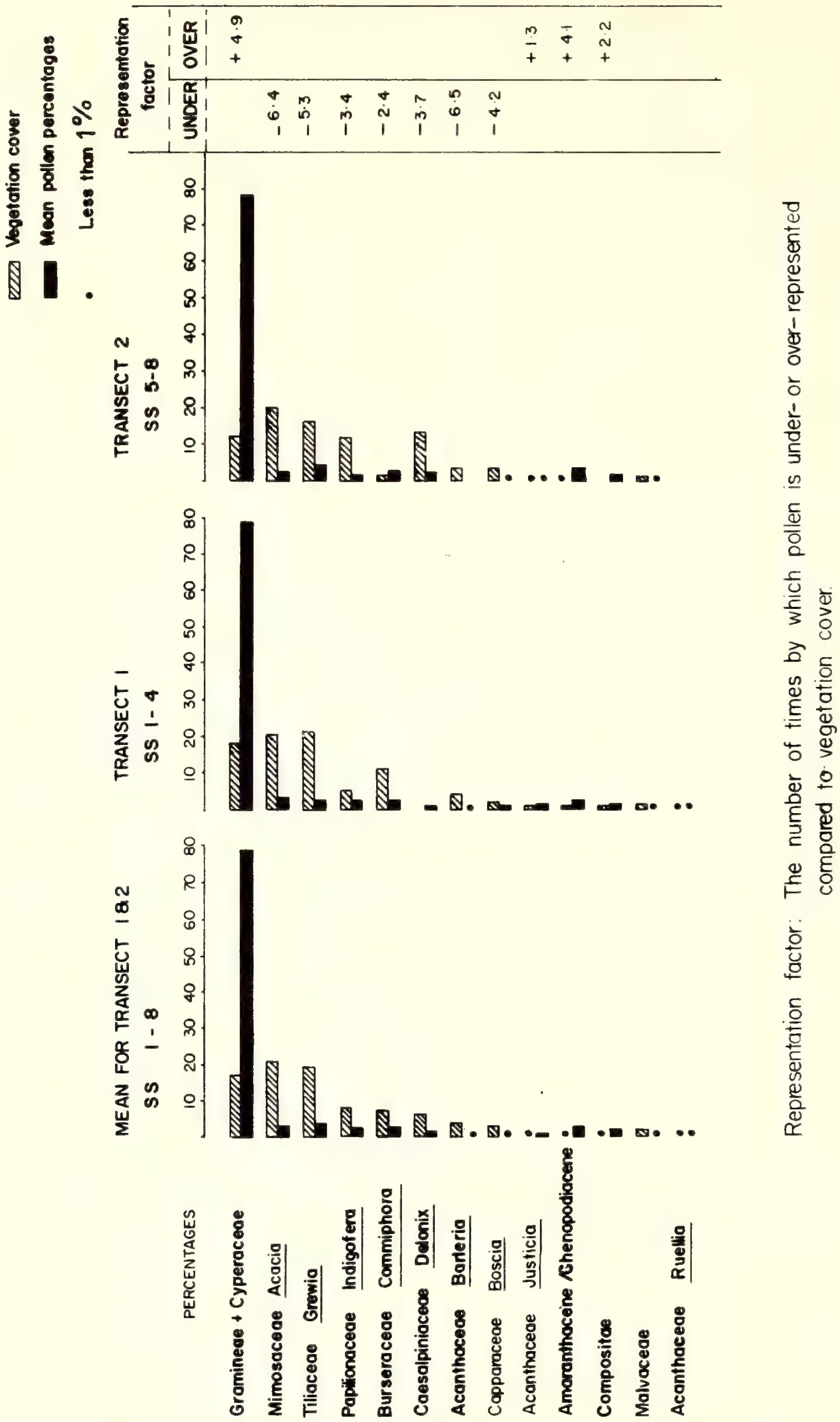


Figure 5. Pollen percentages of taxa present in surface soil samples compared with percent cover in the vegetation transects.

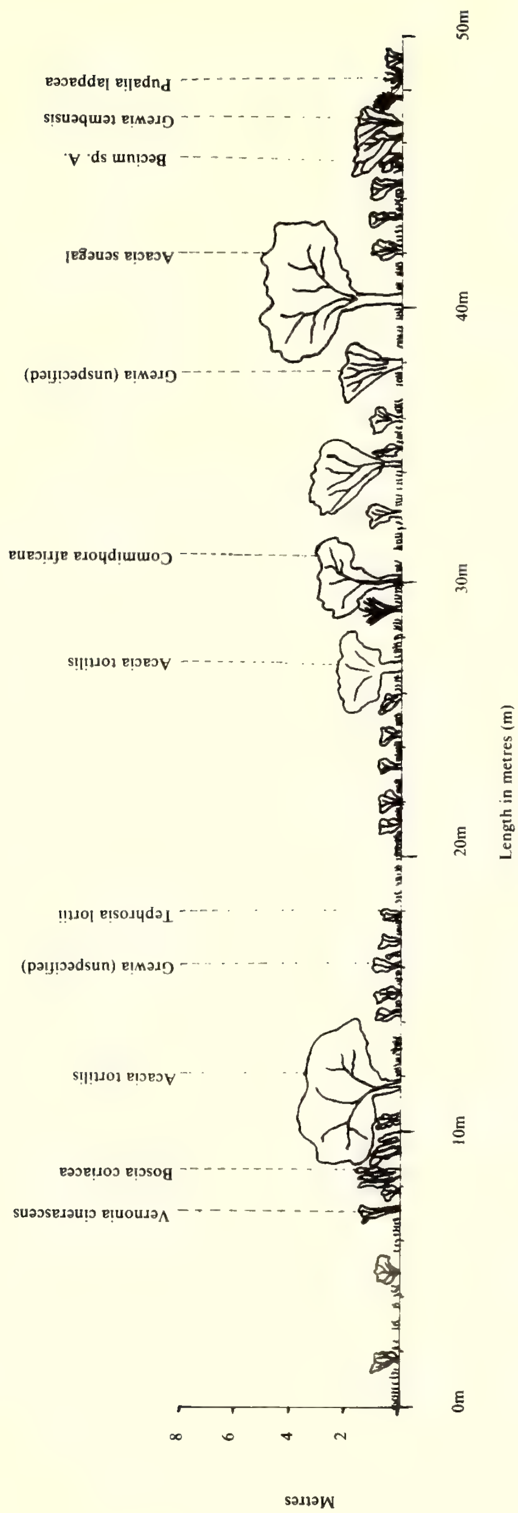


Figure 6a. Transect 1 (0-5m).

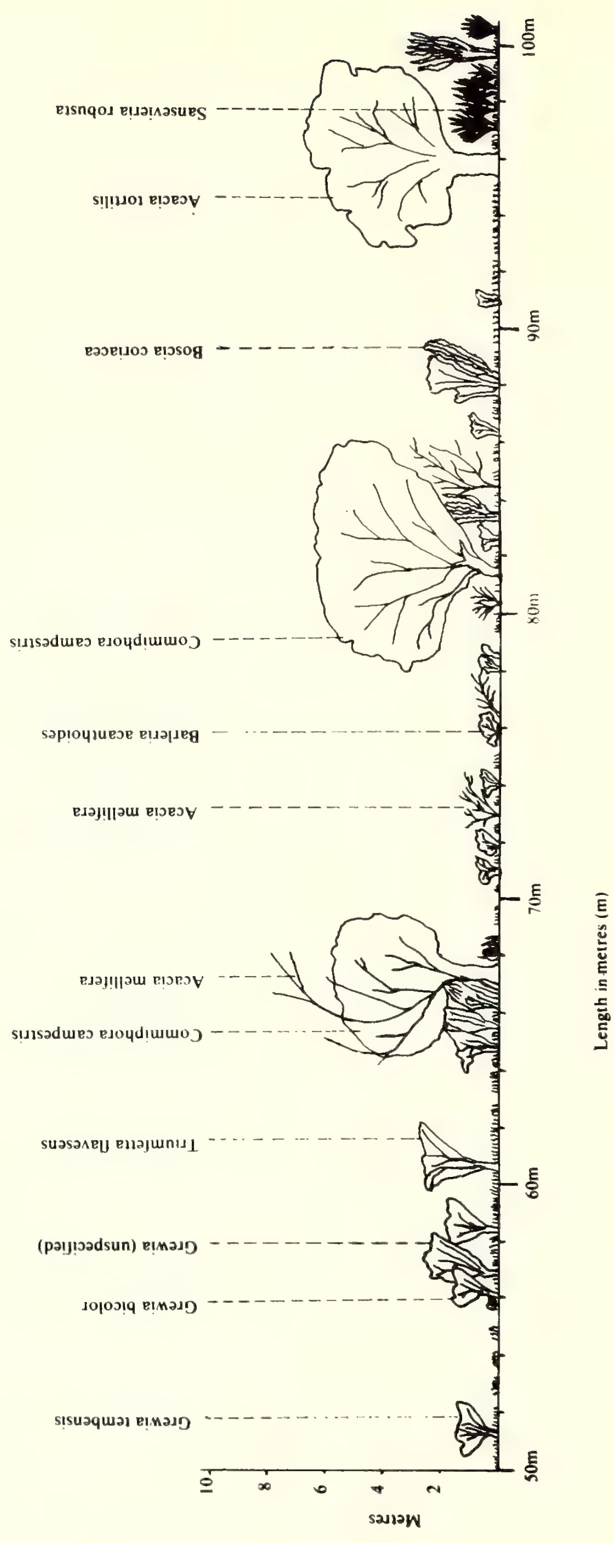


Figure 6b. Transect 1 (50-100 m).

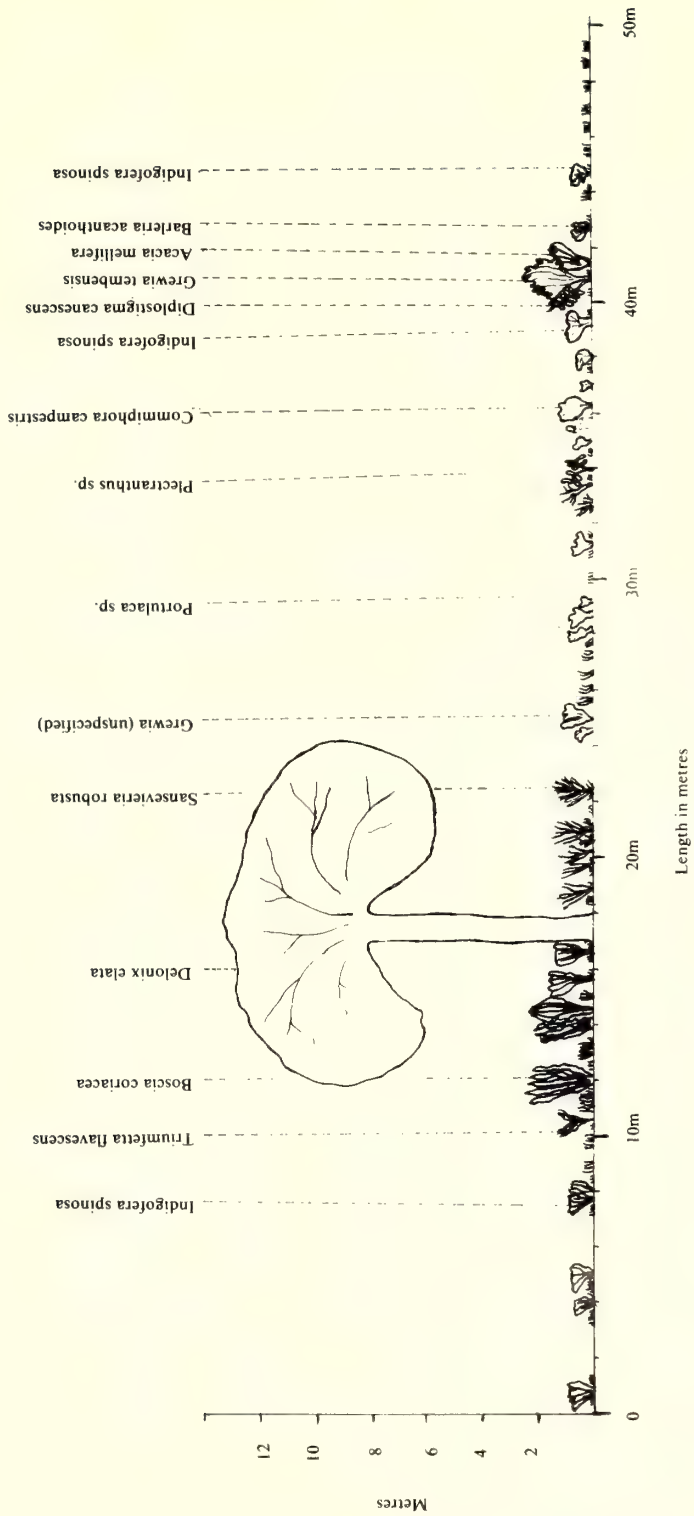


Figure 7a. Transect 2 (0-50 m).

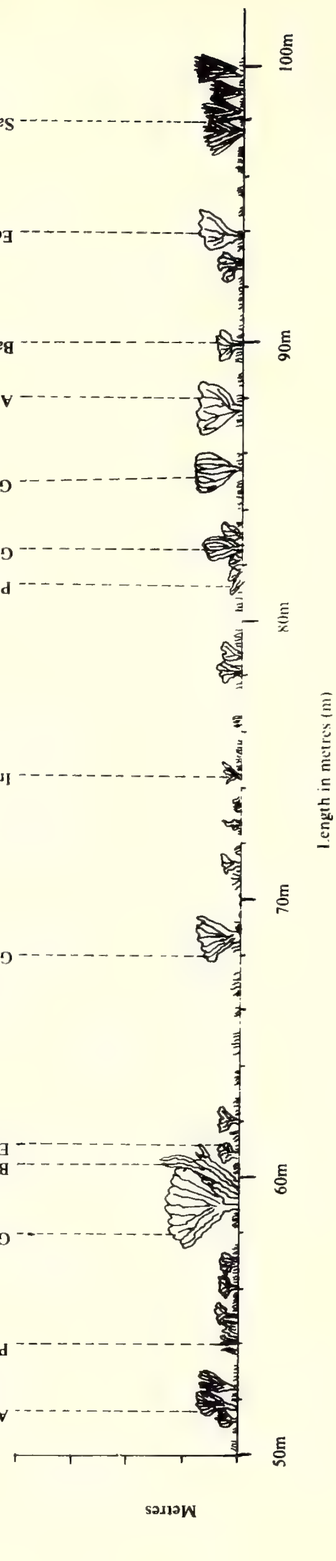


Figure 7b. Transect 2 (50-100 m).

represented: Gramineae, Cyperaceae, Amaranthaceae/Chenopodiaceae, *Acacia, Grewia, Indigofera, Delonix,* Compositae, *Commiphora, Boscia* and *Justicia.* Well represented means that pollen was found in at least four of the eight soil surface samples. *Pinus* pollen was found in all surface samples and in relatively higher percentages than those of *Podocarpus. Pinus* and *Podocarpus* pollen are the only well represented allochthonous pollen in the analysis. The percentage values of *Commiphora* were very variable throughout the samples. In SS_7, there was 12% *Commiphora* pollen while neighbouring samples had none. *Boscia* pollen was present in all the samples from transect one but absent in three out of four surface samples from transect two. The percentage of unrecognizable pollen found in trap samples were much lower than in the soil surface samples. OJ_3 1984 and OJ_3 1983 have 4% and 2% unrecognizable pollen respectively. The soil surface sample SS4 had the lowest with 13% of unrecognizable pollen and SS_2 the highest (37%). SS_4 also had a relatively low percentage of grass pollen while other taxa were present in relatively higher percentages than found in other samples. The trap samples OJ_3 (1983 and 1984) showed high percentages of Compositae pollen compared to the surface soil sample. Cyperaceae pollen percentages were much lower in the trap samples than in soil surface samples.

Pollen trap samples

Relative pollen percentages for taxa from nine trap samples collected over a period of one month (6th May to 9th June 1983) are shown in a histogram in Figure 4. To compare the results of three different types of traps, open jar (OJ's), funnel traps (FT's), and vertical traps (VT's), the analysis from samples of individual traps of the same type are placed next to each other in the diagram. OJ1 and FT1, were placed on the same spot, and their contents show similarities in the percentages of *Indigofera, Justicia, Grewia* and *Acacia.* OJ_2 and FT_2 were also placed together and showed similarities in the pollen percentages of *Indigofera*, Amaranthaceae/Chenopodiaceae, Compositae, *Acacia* and Loranthaceae types. *Ocimum* pollen was relatively more abundant in OJ_1 than in FT_1 and also in OJ_2 than in FT_2. Among the traps placed outside the transect, OJ_3 and VT_3 were placed beside one another. The percentages of *Compositae* pollen type was much higher in OJ_3 than in VT_3 and *Gramineae* higher in VT_3 than in OJ_3. *Rhus* type and *Pinus* type were the two allochthonous pollen types found in VT_3 but absent in OJ_3. The annual trap sample OJ_3 1984 shown in Fig. 3 had more pollen taxa than any of the one month trap samples.

Vegetation and pollen rain comparisons

In Fig. 5 pollen percentages of genera/taxa present in the soil surface amples are shown in histograms next to the histograms of the percentages of these taxa as they occur in the vegetation. The pollen percentages of Gramineae and Cyperaceae were added together for the purpose of comparing with the vegetation percentages.

The pollen of Gramineae plus Cyperaceae was the most over-represented, being 4.9 times more than its vegetation percentage in the transects. The other pollen types over-represented were Acanthaceae-*Justicia* type Amaranthaceae/ Chenopodiaceae and Compositae. *Barleria* pollen type was the most under-represented followed by *Acacia* and *Grewia* pollen types. None of the tree species was over-represented. Among the shrubs, *Grewia* was predominantly present in the vegetation and also in the pollen rain. Genera and families found in the pollen record as well as in the vegetation are listed in Appendix II.

Pinus pollen type was present in both the soil samples and trap samples although *Pinus* does not occur in the local semi-arid type of vegetation. The same applies to *Rhus* (Anacardiaceae). Though *Tribulus* (Zygophyllaceae) pollen was found in the soil surface samples, no *Tribulus* was recorded in the floral survey. *Tribulus terrestris* does occur in Nairobi District and the Rift Valley (Agnew 1974), and Olorgesailie borders this region.

DISCUSSION

Gramineae pollen was a dominant feature in all the pollen samples analysed for this study. On comparing the vegetation plant taxa percentages with the surface soil and air borne pollen samples, grasses and sedges were over-represented in the pollen rain by a factor of about five times. The great quantities of Gramineae and Cyperaceae pollen found in the modern pollen rain may exaggerate their importance in the vegetation.

A comparison of the surface soil pollen spectra shown in this study with pollen spectra from surface soil samples from other sites in Kenya reveals some interesting similarities. For example, the Gramineae pollen percentages for the soil samples in this study (Fig. 5), resemble the Gramineae pollen percentages in surface samples from Alia Bay at Lake Turkana (Bonnefille & Vincens 1977). Gramineae pollen percentages from Alia Bay ranged from 47.6% to 65.4% and at Olorgesailie they ranged from 42% to 66%. Surface soil samples from Laga Tulu Bor (Bonnefille et Vincens 1977) show close similarities to surface soil samples from Olorgesailie in the pollen percentages for the taxa: Gramineae, *Acacia* and Amaranthaceae/Chenopodiaceae. In the Alia Bay record no *Acacia* was found but the percentages of *Acacia* in the Laga Tulu Bor samples resembled those from Olorgesailie. The vegetation profile sketch of Laga Tulu Bor transect was more similar to that at Olorgesailie than that at Alia Bay. The Alia Bay profile sketch showed no trees. The vegetation in the Turkana areas was characterized as a bushed grassland with *Acacia* and *Commiphora* (Bonnefille et Vincens 1977), and at Olorgesailie the vegetation was characterized as *Acaia-Commiphora* bushland (see 1.2.). Though *Acacia* pollen percentages in the soil samples from Olorgesailie did not differ very much from samples taken at Laga Tulu Bor, there was a clear difference in the *Commiphora* percentages. At Olorgesailie *Commiphora* pollen percentages ranged from 0-11%, but at Laga Tulu Bor

	A Number of pollen taxa present	B Number of taxa with value > 1%	C Number of taxa with value ≤ 1%
OJ_1	13	11	2
OJ_2	11	7	4
OJ_3	10	4	6
OJ average	11.3	7.3	4
FT_1	12	5	7
FT_2	14	3	11
FT average	13	4	9
VT_1	10	3	7
VT_2	11	4	7
VT_3	12	4	8
VT_4	7	4	3
VT average	10	3.8	6.3

Table 3. A comparison of the pollen taxa in trap samples.

percentages did not exceed 0.6%. Since no detailed data about the vegetation in Laga Tulu Bor are available it is not known whether the absence of *Commiphora* pollen is due to an absence of these plants in the vegetation or to anything else. The quite remarkable differences in percentages of *Commiphora* pollen in the different soil samples from Olorgesailie and its near absence in the Turkana area may suggest that *Commiphora* pollen are only very locally dispersed. The fact that many of the *Commiphora* pollen found in the Olorgesailie samples were in relatively bad shape may indicate that *Commiphora* pollen deteriorate relatively easy.

Surface soil sample number SS_4 had the highest number of pollen taxa. It also had the lowest percentage of unrecognizable pollen and the lowest Gramineae pollen percentage. More likely the high grass percentages in the other samples depressed (or constrained) the percentages of other pollen taxa. Among the soil surface samples the unrecognizable pollen percentage ranges from 13% in SS_4 to 37% in SS_2. In the annual trap sample OJ_3 1984 the percentage of unrecognizable pollen was clearly lower than in the soil samples (5%). In addition the diversity in OJ_3 was higher as were the relative amounts of the less common pollen types. This may indicate better pollen preservation in the trap than in the soil samples. Establishing the efficiency of the different trap types presented us with difficulties. It was not possible to compare all the results from the trap samples with the soil surface, because all of the traps (except OJ3 1984) had been collecting pollen over too short a period (one month). The disappearance of pollen traps while in the field reduced the number of trap samples. The results from one annual sample were not adequate for satisfactory explanations.

Table 3 shows that the total number of pollen taxa was quite low. Some taxa might have been included in the unrecognizable pollen count. Whether a pollen trap is an efficient instrument to record modern pollen rain, one has to establish whether the pollen sampled by the trap are representative of the pollen rain of the area. Establishing the pollen rain does have its problems. Pollen preservation is poor in surface soil samples from semi-arid regions like Olorgesailie. Traps seem to be preferable because of the better preservation, but their disadvantage is that pollen in the immediate area of the traps is over-represented. From this study we were not able to establish the true value of the traps, but they appeared to have the advantage of containing better preserved pollen. Since the results of modern pollen studies are meant to be an aid in the interpretation of fossil pollen data, we think that though the preservation in the soil surface samples is poorer than in the trap samples, surface soil samples are preferable over trap samples because they approach the most natural situation.

ACKNOWLEDGEMENTS

We would like to thank the Kenya Museum Society for providing the funds which enabled us to do the field work. We are also thankful to Mr. David Nyakundi of the East African Herbarium, National Museums of Kenya, for assistance in the field and with the identification of plants.

REFERENCES

Agnew, A. D. 1974. Upland Kenya Wild flowers Oxford University Press, 827 p.

Birks, H. J. 1979. Modern pollen assemblages and vegetational history of the moraines of the Klutlan Glacier and its surroundings, Yukon Territory, Canada Quart. Res. 14: 101-129.

Bonnefille, R. 1969. Analyse pollinique d'un Sediment Recent: Vases Actuelles de la Riviere Aouache (Ethiopie). Pollen et Spores Vol. XI - No. 1.

Bonnefille, R. 1971. Atlas des Pollens D' Ethiopie: Principales Especes des Forets de Montagne. Pollen et Spores Vol. XIII - No. 1.

Bonnefille, R. et Vincens, A. 1977. Representation pollinique environments arides a l'est du Lac Turkana (Kenya). Recherches Francaises sur le Quarternaire INQUA 1977 Supplement au Bulletin AFEQ 1977-1, No. 50.

Bonnefille, R., et Riollet, G. 1980. Pollens des Savanes d'Afrique Orientale. Editions du Centre National de la Recherche Scientifique, 140 p., 113 pl.

Bradshaw, R. H. W. 1981. Modern pollen presentation factors for wood in southeast England. J. Ecol. 69: 45-70.

Caratini, Cl., and Guinet, Ph. 1974. Pollen et spores d'Afrique tropicale. Centre d'etudes des geographie tropicale. Talence France.

Dale, I. R., and Greenway, P. J. 1961. Kenya Trees and Shrubs. Buchanans Estates, 654 p.

Faegri, K., and Iversen, J. 1975. Textbook of pollen analysis. Blackwell Oxford, 3rd ed., 195 p.

Ferguson, I. K., and Strachan, R., 1982. Pollen morphology and taxonomy of the Tribe Indigofereae *(Leguminosae: Papilionoideae)* Pollen et Spores, Vol. XXIV No. 2.

Hamilton, A. C. 1976. Identification of East African Urticales pollen. Pollen et Spores Vol. XVIII - No.1.

Heusser, C. J. 1971. Pollen and spores of Chile. The University of Arizona Press, Tucson, Arizona.

Ibe, R. A. 1984. Modern pollen rain -- vegetation relations at four different elevations on Slide Mountain, Catskill Mountains, New York. Bull. Torrey Bot. Club Vol. 3 No. 1: 96-102.

Isaac, G. L. 1968. The Acheulian site complex at Olorgesailie, Kenya: A contribution to the Interpretation of Middle Pleistocene Culture in East Africa. Ph.D. Thesis Cambridge.

Jacobs, B. F. 1982. Modern pollen spectra from surface soil samples, Northern Nayarit, Southern Sinaloa, Mexico. J. Arizona Nevada Acad. Sc. 17: 1-14.

Kingham, D. L. 1976. A study of the pollen morphology of Tropical African and certain other Vernonia (Compositae:). Kew Bull. Vol. 31(1): 9-26.

Moore, P. D., and Webb, J. A. 1978. An illustrated guide to pollen analysis. Hodder and Stoughton, 133, pp.

Senesse, S. 1980. *Fam. Caesalpiniaceae*. Pollen et spores, Vol. XXXI No.3-7: 355-423.

Trump, E. C. 1967. Vegetation. In: Nairobi City and Region ed. W. T. W. Morgan, Nairobi, Oxford University Press.

APPENDIX I

Laboratory Treatment

The method followed in the treatment of samples for pollen analysis is that described by Faegri and Iversen (1975), which can be outlined as follows:-

A. Trap samples

-- Samples were put in centrifuge tubes
-- 6 ml. of 10% KOH was added to each sample, and put in hot water bath for about 3 minutes.
-- Samples were sieved using a 250 microns aperture diameter sieve and washed through with distilled water. Materials retained by the sieve were discarded.
-- Centrifuged at 3000 R.P.M. for 3 minutes and decanted by pouring the supernate.
-- Samples were water washed twice using distilled water.
-- About 6 ml. of glacial acetic acid was added to each sample.
-- Centrifuged and decanted.
-- About 6 ml. of acetolysis mixture was added. The acetolysis mixture was prepared to consist 9 parts acetic anhydride and 1 part concentrated sulfuric acid. The samples in acetolysis mixture were put in hot water bath for a minute.
-- Centrifuged and decanted.
-- 6 ml. of glacial acetic was added.
-- Centrifuged and decanted.
-- Two water washes.
-- Transferred into vial tubes.
-- Added 2-3 drops of glycerine.
-- Water was evaporated by putting the samples in the oven at about 40°C overnight.
-- Samples were accessioned into the pollen residue collection, and slides were prepared.

B. Surface soil samples

-- Approximately 15 grams from each sample was put in centrifuge tubes.
-- 10% HCl was added to each sample, until there were no further effervescence.
-- Centrifuged and decanted.
-- 10 ml. of 10% KOH was added to each sample and put in hot water bath for about 3 minutes.
-- Samples were sieved using a 250 microns aperture diameter sieve and washed through with distilled water. Materials retained by the sieve were discarded.
-- Two water washes (putting distilled water in the samples, centrifuging and decanting in each of the water washes).
-- The samples were transferred to polythene centrifuge tubes.
-- About 6 ml. of 40% of hydrofluoric acid (HF) was added to each sample and placed in hot water bath for 30 minutes (for some samples the 30 minutes period was extended to 1 hour or more due to presence of undissolved sand particles).
-- 6 ml. of 10% HCl was added to each sample and warmed a little (not boiling).
-- Two water washes.
-- 6 ml. of acetolysis mixture (prepared as in the case of the trap samples), was put in every sample place in hot water bath for 1 minute.
-- Centrifuged and decanted.
-- 6 ml. of glacial acetic acid was added.
-- Centrifuged and decanted.
-- Two water washes.
-- Added about 2-3 drops of glycerine.
-- Water was evaporated by putting the samples in the oven at about 40°C overnight.
-- Samples were accessioned into the pollen residue collection, and slides were prepared.

APPENDIX II

Below is a list of plant species found in Olorgesailie archeological site area during fieldwork. Representation in the pollen rain is shown by asterisk(*) in the appropriate level (genus/family) of pollen identification.

ACANTHACEAE
**Barleria acanthoides* Vahl
**Barleria eranthemoides* C.B.Cl.
Blepharis linariifolia Pers.
Dicliptera sp. "C" of Upland Kenya Wild Flowers
Ecbolium revolutum (Lindau) C.B.Cl.
**Justicia odora* (Forssk.) Vahl
**Ruellia prostata* (Nees) T. Anders.

ADIANTACEAE
Actiniopteris radiata (Swartz) Link

AGAVACEAE
Sansevieria robusta N.E. Br.

AIZOACEAE
Corbichonia decumbens (Forssk.) Exell
Trianthema triquetra Willd.
Zaleya pentandra (L.) Jeffrey

*AMARANTHACEAE
Pupalia lappacea (L.) Juss.

APOCYNACEAE
Catharanthus roseus (L.) G. Don (exotic)

ASCLEPIADACEAE
Caralluma gracilipes K. Schum.
Cynanchum tetrapterum (Turcz.) R. A. Dyer
Diplostigma canescens K. Schum.

BALANITACEAE
Balanites aegyptiaca (L.) Del.

BORAGINACEAE
Heliotropium somalense Vatke
Heliotropium strigosum Willd.

BURSERACEAE
**Commiphora africana* (A. Rich.) Engl.
**Commiphora campestris* Engl.

CAPPARACEAE
**Boscia coriacea* Pax
Cadaba farinosa Forssk.

COMMELINACEAE
Commelina albescens Hassk.
Commelina benghalensis L.
Commelina imberbis Hassk.

*COMPOSITAE
Vernonia cinerascens Sch. Bip.

*CUCURBITACEAE
Kedrostis gijef (J.F.Gmel.) C. Jeffrey

*CYPERACEAE
Kyllinga alba Nees
Kyllinga welwitschii Ridley

*EUPHORBIACEAE
Dalechampia scandens Benth.
Euphorbia acalyphoides Boiss.
Euphorbia agowensis Boiss.
Euphorbia scheffleri Pax
Euphorbia tirucalli L.
**Jatropha fissispina* Pax
Phyllanthus maderaspatensis L.
Phyllanthus rotundifolius Willd.

GERANIACEAE
Monsonia senegalensis Guill. & Perr.

*GRAMINEAE
Chloris roxburghiana Schult.
Dactyloctenium bogdanii S. M. Phillips
Enneapogon cenchroides (Roem & Schult) C. E. Hubb.
Eragrostis cilianensis (All.) F. T. Hubb.
Sporobolus jacquemontii Kunth
Tetrapogon cenchriformis (A. Rich.) W.D. Clayton

LABIATAE
Becium sp. 'A' of Upland Kenya Wild flowers
Capitanya otostegioides Guerke
**Ocimum lamiifolium* Benth.

LILIACEAE
Asparagus sp. = P.E. Glover & Samuel 2812
Chlorophytum tenuifolium Bak.

*LORANTHACEAE
**Odontella ugogensis* Engl.

*MALVACEAE
Abutilon grandiflorum G. Don
Hibiscus micranthus L.f.
Pavonia patens (Andr.) Chiov.

MIMOSACEAE
**Acacia mellifera* (Vahl) Benth.
**Acacia nubica* Benth.
**Acacia senegal* (L.) Wild.
**Acacia tortilis* (Forssk.) Hayne
Albizia sp.

NYCTAGINACEAE
Boerhavia erecta L.

PAPILIONACEAE
Crotalaria laburnifolia L.
**Indigofera cufodontii* Chiov.
**Indigofera microcharoides* Taub.
**Indigofera spinosa* Forssk.
**Tephrosia lortii* Bak.
Vigna macrorhyncha (Harms) Milne-Redhead

POLYGALACEAE
**Polygala amboniensis* Gurke
**Polygala senesis* Klotzsch

PORTULACECEAE
Portulaca sp.
Talinum portulacifolium (Forssk.) Schweinf.

RUBIACEAE
Pentanisia ouranogyne S. Moore

SCROPHULARIACEAE
Craterostigma sp. "C" of Upland Kenya Wild Flowers
Cycnium veronicifolia (Vatke) Engl.

SOLANACEAE
**Solanum taitense* Vatke

STERCULIACEAE
Hermannia uhligii Engl.
Sterculia stenocarpa H. Winkler

TILIACEAE
**Grewia bicolor* Juss.
**Grewia tembensis* Fresen. var. *kakothamnos* (K. Schum.) Burret
**Grewia villosa* Willd.
Triumfetta flavescens A. Rich.

VERBENACEAE
Lantana viburnoides (Forssk.) Vahl

VITACEAE

Cissus quadrangularis L.

Cissus rotundifolia (Forssk.) Vahl

Cyphostemma sp. "C" of Upland Kenya Wild Flowers.

Printed in Kenya by,
Kenya Litho Ltd., Changamwe Road,
P.O. Box 40775,
Nairobi Kenya.

UTAFITI Volume 1 Number 1

JUNE 1988

Abstract: vegetation studies based on two transects of 100 m each have been analysed in their relative percentage cover and the occurrence frequency of species. Eight surface soil samples taken from the two transects were analysed for their pollen contents. A comparison was made between the relative percentages of the taxa common in both the vegetation and the pollen samples. A pollen trap sample obtained through a period of one year was analysed for pollen content and compared with pollen spectra from soil samples. Three types of artificial pollen traps were used to obtain one month pollen records to establish the most useful type of trap. A checklist of the plants occurring at the site is given.

UTAFITI is published several times a year, and incorporates original research papers on work carried out at the National Museums of Kenya.
Every paper is peer-reviewed by professionals from outside the Museums.

Typesetting and layout done at the Southern Methodist University, Dallas, Texas, U.S.A.
Produced by the National Museums of Kenya, P.O. Box 40658, Nairobi, Kenya

Printed by Kenya Litho Ltd., Changamwe Road, P.O. Box 40775, Nairobi.